The JCM Terrain Editor Guide

Version 2.2

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The JCM Terrain Editor

The Terrain Editor is an interactive file-editing program that creates and/or modifies the terrain and screen data files used in JCM.

NOTE: Terrain files created using earlier versions of the Janus or the JCM 1 version of the Terrain Editor will not be compatible with the JCM 2 version. A file translator has been provided to those sites that have files created with an earlier version of JCM.

The Terrain Editor uses both a Tektronix graphics terminal and a VT100/VT200 compatible terminal to display information and allow input of answers to questions and data by the user.

Getting Started

The Terrain Editor is initiated by selecting option **A1** from the Top Level JCM menu (Fig. 1).

Figure 1   Top Level JCM menu

Once the program is running a prompt will be displayed asking:

> **Tektronix   workstation   number   (1-24)?**

Enter the workstation number where the terrain graphics are to be displayed, and press **RETURN**. The Terrain Editor will only accept workstation numbers in the valid range (1-x, where "x" = the number of workstations available), if an invalid number is entered, the question will be repeated.

Terrain file (RETURN to Exit)?

To this second question, enter the specific terrain file number (1-99). Files 1-49 are assumed to reside in the Master TERRAIN directory; files 50-99 in the user TERRAIN directory. Press **RETURN** to abort the Terrain Editor process and return to the Top Level JCM menu.

If the terrain file is not found or cannot be read, the Terrain Editor displays an error message and repeats the question. If the file is read successfully, the Terrain Editor lists its size, grid resolution, and location:

File   Description

An 80 character comment line will appear on this line.

MAP is nn.nnn km wide and nn.nnn km tall
With grid resolution of nnn x nnn.

The lower left corner is at (nnn.nnn, nnnn.nnn) in UTM coordinates.

NOTE: Universal Transverse Mercator (UTM) is the standard grid coordinate system used on military 1:50,000 scale maps.

Following the selection of the workstation and starting to read the terrain file, the following prompt will be displayed:

Enter contour interval in meters (zero for none):

Entering a number will generate and add the graphical display of contour lines to the terrain screen display providing a means of "seeing" the terrain relief. Lines will be drawn at the interval specified beginning from the lowest data point. If contour lines are not desired for immediate viewing, press **RETURN**. A contour interval may be input anytime during the work session, and may be changed anytime during the work session.

Using the Tektronix Workstation

After answering all the prompts the Tektronix graphics terminal will be activated. The workstation consists of three parts: the monitor (or screen), a graphics tablet, and a puck.

The screen is divided into three separate working areas (Fig. 2). The largest portion
of the screen displays the terrain file, and is the main working area for modification
of the terrain data. Along the right side are two areas, one on top of the other. The
rectangular area on top is the menu area which allows access to the utilities which
modify or change the terrain data. The small area below is a duplicate miniature of
the large terrain display. The initial screen graphics will be generated in the
following sequence: Contours (if requested), Trees, Cities, Water, Roads, Rivers,
Lakes, and lastly the Main Menu. Upon completion of the terrain display, a cursor
will appear on the screen allowing input from the graphics tablet and puck.
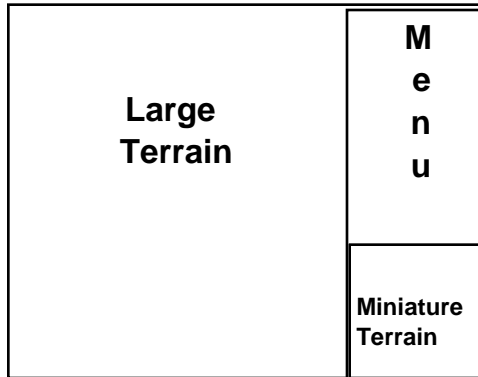
Figure   2   Tektronix   screen   working   areas

The graphics tablet and puck allow input of data graphically. The relative position of
the puck on the graphics tablet is displayed graphically on the screen with a cursor
(a white cross with a red square in the center). To make selections or "picks" move
the puck on the graphics tablet until the cursor on the screen is on top of the desired
location or item on the screen and press the yellow button. Use the yellow button for
all picks, unless otherwise specified.

Main Menu

The Main menu (Fig. 3) allows the user to select the type of graphics feature to
generate or action to perform. The Main menu options are CLEAR, CITIES, CONTOUR,
CONTROL, UTM GRID, RIVERS, ROADS, TREES, ZOOM and WATER.
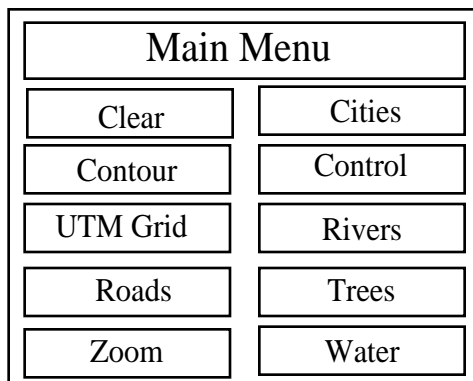
Figure 3   Main   menu

The Main menu is displayed at the top of the menu area. All sub-menus except the
ZOOM sub-menu are displayed below the Main menu. The ZOOM sub-menu is displayed
below the area where the other sub-menus appear.

NOTE: Remember, to choose an option use the yellow button on the graph tablet puck. The chosen function will be highlighted, and the Terrain Editor is ready to work.

Clear

The CLEAR option refreshes the screen, clearing it of unwanted graphics which may
have been left on the screen.

Cities

Cities or urban areas are displayed in varying shades of yellow on the screen,
representing seven types of urban areas as differentiated by density and height.
Urban areas may be input, modified, or deleted using the following CITIES sub-menu
(Fig. 4) options: DIGITIZE, REFRESH, TRANSFER, DELETE ALL, VALUE 0, VALUE 1,
VALUE 2, VALUE 3, VALUE 4, VALUE 5, VALUE 6 and VALUE 7.

Cities Menu	
Digitize	Refresh
Transfer	Delete All
Value 0	Value 1
Value 2	Value 3
Value 4	Value 5
Value 6	Value 7

Figure   4   Cities   sub-menu

Digitize   Cities

The DIGITIZE option allows terrain features to be input by tracing them from a map
taped to the graph tablet. Insure the map is firmly attached to the graph tablet, and
that the North/South grid lines are parallel with the left and right edges of the
graph tablet. After the option has been selected a prompt will appear on the
Tektronix   screen:

Indicate   the   lower   left   corner   on   the   screen

Select a point on the screen that identifies the lower left corner of the area to be
digitized. After picking the first screen point, the next prompt will appear:

Indicate   the   same   location   on   the   map

NOTE:	The DIGITIZE function will be aborted if the cursor is in the menu area when a point on the map is picked to correspond to a point on the screen. When this happens the DIGITIZE function has to be reselected and the screen points chosen so that the corresponding map points do not cause the cursor to be in the menu area.

Move the puck on the graph tablet until the puck cross-hairs (in the plastic in front
of the buttons) are directly over the map point which corresponds to the screen
point just selected. Pick this point on the map without regard for the cursor location
on the screen. The prompts will now be repeated to allow selection of the upper right
corner on the screen and map which will complete identification of the work area.
After the last point is selected, the screen area defined will be magnified to fill the
large work area.

NOTE:	It is a good idea to tape the map to the graphics tablet to insure that it is not moved once points have been selected.

Now that the area to be digitized has been defined work may begin. Select any of the
other sub-menu options, and enter data by picking points within the area defined ON
THE MAP. Input all information by selecting points on the map. Information input
will be automatically adjusted, scaled, and displayed on the screen. **IGNORE   THE
SCREEN   CURSOR   POSITION!**   The DIGITIZE feature remains in effect for all sub-
menu options until canceled.

When finished digitizing within the area defined, reselect the DIGITIZE menu option
to return to normal operation, or select CLEAR .

After the DIGITIZE option has been selected the first time, then on every subsequent
time it is selected the program will ask:

Do   you   wish   to   reuse   the   previous   mapping   (Y/N)?

Enter **Y** on the Tektronix keyboard and press **RETURN** to reset the digitize function
exactly as it was when it was turned off. Enter **N** to define a new digitization mapping.

NOTE:	If the large terrain view is changed using any of the ZOOM options while DIGITIZE is on, the digitize function will be turned off. To restore it reselect DIGITIZE and restore the previous mapping as explained above.

Refresh

Selection of this sub-menu option causes all work displayed in shades of gray to be redrawn on the screen in the proper shade of yellow. Be patient, this takes a few moments.

Transfer

City data contained in a second terrain file may be added to the screen. If a secondary terrain file has not been specified previously, the VT100 terminal will prompt for the file number.

Enter the number if the secondary (transfer from) file.

Terrain file (RETURN to EXIT)?

Enter the specific terrain file number (1-99). Files 1-49 are assumed to reside in the Master TERRAIN directory; files 50-99 in the user TERRAIN directory. Press **RETURN** to abort the Terrain Editor process and return to the Top Level JCM menu. If the file is read successfully, the Terrain Editor lists its size, grid resolution, and location:

Reading file JCM$SYS_TERRAIN:TERAIN41.DAT

File Description
An 80 character comment line will appear on this line.

MAP is nn.nnn km wide and nn.nnn km tall
With grid resolution of nnn x nnn.

The lower left corner is at (nnn.nnn, nnnn.nnn) in UTM coordinates.

Delete All

The DELETE ALL option deletes all city data from the terrain file. If it is selected the following prompt will appear:

ARE you SURE you want to delete ALL city data (Y/N) ?

Enter **Y** to delete all city data. Enter **N** to abort the delete process.

Cities Values (0-7)

Screen data is modified by selecting the value of buildings desired, and defining the area to be filled with that value. Upon selection of the value, the cursor will be replaced with a writing quill. Using the quill like a pen, it will write whenever the yellow button on the puck is depressed and held. When the button is released, the quill will stop writing. Using the quill, draw a line which encloses the area to be filled leaving a small gap between the line ends which will be joined automatically when the button is released. The area will be filled by a shade of gray for easy identification indicating the building value selected (dark gray=1 to white=7, orange=0). Continue to define areas using the current value or select a new one. Areas may be drawn over currently highlighted areas. To erase buildings use VALUE 0.

When finished select REFRESH or any option from the Main menu.

NOTE: If large areas of the screen are being changed, the segment memory space could be filled. If this happens, the terminal will beep. Respond by selecting REFRESH to store current planned which clears the memory area. Continue to make changes, but work with smaller areas.

Contour

The CONTOUR option erases or displays terrain contour lines each time it is selected.

If a contour interval was not specified at the initiation of the program, and the CONTOUR option is selected from the menu the following prompt will appear on the VT100 screen:

Enter contour interval in meters or hit RETURN

To generate contour lines for the first time, enter a contour interval then press **RETURN**. Be patient; it will take a few moments to draw the contour lines on the screen. Upon completion of the drawing process, program control will be returned to the Tektronix screen.

If the CONTOUR option was selected by mistake, press **RETURN** in response to the VT100 prompt, and control will be returned to the Tektronix screen without drawing the contour lines.

If a contour interval was entered at the initiation of the program the Main menu will be initiated with the CONTOUR option highlighted, and the contour lines displayed. If the CONTOUR option is selected while highlighted, the contour lines will be erased from the screen, and the highlight turned off. If the CONTOUR option is selected from the Main menu while not highlighted (an interval was not input when the program was started, or the highlight has been selected and turned off) the following prompt will appear on the VT100 screen:

> **Current   contour   interval   is   nn   meters**
> **Do   you   wish   to   change   it   (Y/N)?**

"nn" represents a number. If the answer is **N** then the original contour lines are redisplayed, and the interval is not changed. If the answer is **Y** another prompt appears:

> **Enter   contour   interval   in   meters   (zero   for   none):**

If a number is entered followed by a **RETURN**, a new set of contour lines is drawn at the designated interval. If **RETURN** is pressed without a number being input the original prompt is redisplayed.

Whenever contour lines have been generated and erased from view, reselection of the CONTOUR option will allow them to be redisplayed. The redisplay of previously drawn contour lines occurs very quickly.

Control

The Control sub-menu (Fig. 5) offers a variety of special features as well as the ability to create and save terrain files. The CONTROL sub-menu options are CELLS, DESCRIPTORS, EXIT, GROUND CONTOURS, LOCATION, LOS, WRITE TERRAIN, SECONDARY and DEFINE.

```
┌─────────────────────────────────────┐
│          Control Menu                │
├──────────────────┬──────────────────┤
│      Cells       │   Descriptors    │
├──────────────────┼──────────────────┤
│      Exit        │    Grnd Cont     │
├──────────────────┼──────────────────┤
│    Location      │       LOS        │
├──────────────────┼──────────────────┤
│  Write Terrain   │    Secondary     │
├──────────────────┼──────────────────┘
│     Define       │
└──────────────────┘
```
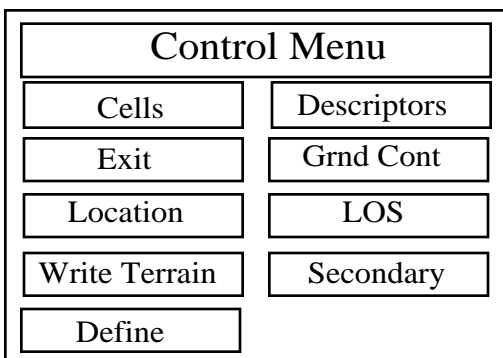
Figure   5   Control   sub-menu

Cells

The terrain data is saved within a matrix of data cells. The maximum size of this matrix is 1000 x 1000 cells. To see graphically how the cells have been defined, use this option. The CELLS sub-menu (Fig. 6) will be displayed. The CELLS sub-menu options are CITIES, RIVERS, ROADS, TREES, and WATER.

```
┌─────────────────────────────────────────────┐
│  ┌─────────────────────────────────────────┐ │
│  │              Cells Menu                   │ │
│  └─────────────────────────────────────────┘ │
│  ┌──────────────────┐  ┌───────────────────┐ │
│  │      Cities       │  │      Rivers        │ │
│  └──────────────────┘  └───────────────────┘ │
│  ┌──────────────────┐  ┌───────────────────┐ │
│  │      Roads        │  │      Trees         │ │
│  └──────────────────┘  └───────────────────┘ │
│  ┌──────────────────┐                         │
│  │      Water        │                         │
│  └──────────────────┘                         │
└─────────────────────────────────────────────┘
```
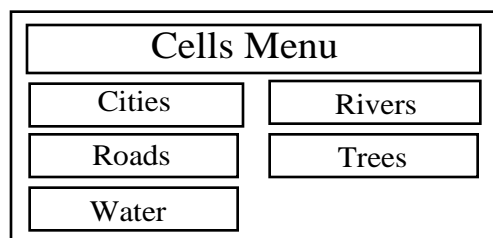
Figure 6   Cells   sub-menu

Select the type of feature desired, and the cell matrix will be displayed and filled in with a number corresponding to the appropriate value of the requested type of feature. Rivers and roads have a value of 1. The ZOOM menu may be used without erasing the cell grid display. Select any other menu option when finished.

Descriptors

Selection of the DESCRIPTORS sub-menu option allows the height, density and depth data values for buildings, trees and water to be reviewed and/or modified on the VT100 screen.

The city and tree values 0 through 7 are each described by two data elements. PLOS is the probability that Line-of-Sight (LOS) will be blocked for each 100 meter width of city or tree area (example: 9 = 9% probability that LOS is blocked). The probability is logarithmic as each additional 100 meter section is examined until LOS is blocked, or the far edge of the area is reached. Height expresses the building or tree height in meters (example: 16=16 meters).

The water values 0 through 7 are each described by one Depth data element. The Depth is expressed in meters. The default values used are:

Value	TREES Height (m)	P(LOS) (%)	BUILDINGS Height (m)	P(LOS) (%)	WATER Depth (m)
0	0	0	0	0	0
1	3	9	2	76	1
2	6	17	5	94	20
3	9	25	7	99	30
4	12	32	9	100	40
5	15	38	11	100	50
6	18	44	14	100	60
7	21	49	16	100	9999

Use the **TAB** and **BACKSPACE** keys on the keyboard to move between values. Use the **DELETE** key to erase numbers to be changed, then type in the new numbers. The

{**PF2**} key will display a HELP message on the screen for each column. Press **RETURN** when   finished.

Exit

Select this option to complete the process. When this option is selected, a PLEASE VERIFY option will appear below the bottom menu. To continue the exit process move the cursor over the PLEASE VERIFY option and press the yellow button. The next prompt will appear on the VT100 screen:

> **Enter Terrain file number to write (50-99), -1 to repent, 0 for no output**

To create a terrain file containing the current data as modified, type in a number from 50 through 99. Any entry other than a number within this range, **-1**, or **0** will result in the question being repeated. To cancel the exit process and return to editing the terrain data, type a **-1**. To continue the exit process, without saving the terrain data or creating a new terrain file, type **0**. The following message will be displayed:

> **Writing   file   JCM$USR_TERRAIN:TERAIN##.DAT**

As the exit process continues another prompt will be displayed on the VT100 screen:

> **Enter Screen file number to write (50-99), -1 to repent, 0 for no output:**

To create a screen file containing the current picture as modified, type in a number from 50 through 99. Any entry other than a number within this range, **-1**, or **0** will result in the question being repeated. To cancel the exit process and return to editing the terrain data, type a **-1**. To continue the exit process, without saving the screen data or creating a new screen file, type **0**.

Following a correct response, either the exit process will be aborted and editing may be resumed, or the process will be completed. When a screen file is requested, a VT100 prompt will identify that the work is completed:

> **Select screen file size. Default is current terrain file size for 500 x 500 or smaller, 1/2 terrain file size for larger than 500 x 500. Smaller files do not affect the simulation, only the terrain display.**
>
> **Terrain file size is 200 x 200.**
>
> **For Example: For a   You get a**
> **   Terrain of   Screen of**

1.   **Current size**   (1000 x 1000   -> 1000 x 1000).
2.   **1/2 Current size**   (1000 x 1000   ->   500 x 500).
3.   **!/3 Current size**   (1000 x 1000   ->   333 x 333).
4.   **1/4 Current size**   (1000 x 1000   ->   250 x 250).
5.   **Do not write a screen file.**

**Press <RETURN> for the default or enter a number in
range of 1-5.**

Selection [1] ?

>> Creating screen file JCM$USR_SCREEN:TSCREEN99.DAT

Finished - hit RETURN to exit.

Write another size screen file (Y/N) [N] ?

Press **RETURN** and the Tektronix screen will be cleared. The JCM Top Level menu will
be returned to the VT100 screen.

Grnd Contour

The GRND CONTOUR option allows the terrain between two identified points to be
viewed from the side as a cross-section. Several prompts will appear on the VT100
screen, the first of which is:

**Observer height = nnn meters. Enter new height (or hit
RETURN):**

"nnn" represents the observer height above the ground. Either enter a new number
of meters to change the observer height or press **RETURN** to continue.

**Target height = xxx meters. Enter new height (or hit
RETURN):**

"xxx" represents the target height above the ground. Either enter a new number of
meters to change the height of the target or press **RETURN** to continue.

Return to the Tektronix display, moving the cursor to a desired observer location and
press the yellow button once. A white **O** will appear to mark the spot. As the cursor is
moved an orange line will connect it to the **O** until a second point is selected to
identify the target location. When the second point is picked, it will be marked with a
T, and will be connected to the **O** with an orange line. Simultaneously, a rectangle
will appear at the bottom of the menu area displaying the shape of the land between
these points as seen from the side. If LOS between the two points is blocked, the word
"Blocked" will appear below the line.

To see other cross-sections, pick the **O** or **T**, and place it anywhere on the screen.
Each time one of them is moved, a new ground contour will be drawn at the bottom of
the menu area. Select any other menu option to continue.

Location

This option prints location and elevation data to the bottom of the Tektronix screen
for any point selected. Move the cursor to the desired location and push the yellow
button. An eight digit UTM grid coordinate followed by the elevation above sea level
(in kilometers) will be displayed at the bottom of the Tektronix screen. Continue to
select new points, or pick any other menu option to continue.

Use the thumbwheel located on the upper right side of the Tektronix keyboard to
scroll previously displayed location data back into the single line viewing area.

LOS

This option allows display of an observers viewing capabilities, or what the observer
could see from any given point. A prompt will appear on the VT100 screen asking:

> **Observer height = nnn meters. Enter new height (or hit
> RETURN):**

"nnn" represents the observer height above the ground. Either enter a new number
of meters to change the observer height or press **RETURN** to continue.

> **Observer Range = yy km. Enter new range (or hit RETURN):**

"yy" represents the maximum distance (in kilometers) the observer can see. Either
enter a new number of kilometers to change the range of view, or press **RETURN** to
continue.

Move the cursor to the desired observation point, and press the yellow button. After a
brief pause, a LOS fan will be drawn on the screen, centered on the point selected.
The white circle shows the maximum range of view from the observation point.
Terrain areas within the circle which can be seen are shown with orange lines
emanating from the observation point. Areas not containing orange lines cannot be
seen due to ground, trees, or buildings being in the way. Continue to pick other
observation points, or select any other menu option to continue.

Write Terrain

This option allows the current terrain data to be saved in a new terrain file, without
exiting. When selected, the following prompt will appear on the VT100 screen.

Enter terrain file number to write (50-99), -1 to cancel, 0 for no output:

To create a terrain file containing the current data as modified, type in a number from 50 through 99. Any entry other than a number within this range, **-1**, or **0** will result in the question being repeated. Enter a **-1** to return to the Tektronix screen without creating a terrain file. The following message will be displayed:

Writing   file   JCM$USR_TERRAIN##.DAT

Secondary

This option allows a second terrain file to be read. The prompts on the VT100 screen to select the file are the same as for the initial selection of the primary file. After the file has been read, selected data may be "transferred" using the appropriate TRANSFER option in other sub-menus.

Define

The DEFINE option allows files with a larger cell matrix (less than 1000x1000) to be redefined with a smaller cell size. It also allows an area within a terrain file to be redefined as a new, separate terrain file of its own. There are four sub-menu options: EXPAND/DEFINE, INPUT AREA, LOWER CORNER, and UPPER CORNER.

```
┌─────────────────────────────────────┐
│  ┌────────────────────────────────┐ │
│  │         Expand Menu            │ │
│  └────────────────────────────────┘ │
│  ┌──────────────┐ ┌───────────────┐ │
│  │ Expand/Define│ │  Input Area   │ │
│  └──────────────┘ └───────────────┘ │
│  ┌──────────────┐ ┌───────────────┐ │
│  │ Lower Corner │ │ Upper Corner  │ │
│  └──────────────┘ └───────────────┘ │
└─────────────────────────────────────┘
```
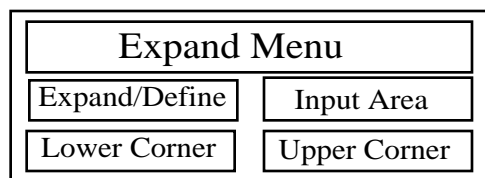
Figure   7   Define   sub-menu

Expand/Define

To expand the number of cells in the current terrain file, or an area defined using the other DEFINE menu options, select EXPAND/DEFINE. The following prompt will appear on the VT100:

Do you want to save the current terrain (Y/N)?

Answering **N** will continue the process without first saving the current set of terrain data. Answer **Y** to save a copy of the current data set before modifications are made. If **Y** is answered:

Enter terrain file number to write (50-99), -1 to repent, 0 for no output:

If a valid number is input, a terrain file will be created, followed by the initiation of the expansion program. If a **0** is input, the expansion program will be initiated without the creation of a terrain file containing the original set of data.

Following the initiation of the expansion program the following messages will be displayed on the VT100 screen:

> **Expansion in progress for the next several minutes.**
> **STEP 1:   Expanding the terrain data**
> **STEP 2:   Recreating the terrain graphics**
>
> **New map is nn.nnn km wide and nn.nnn km tall**
> **With grid resolution of nnn x nnn.**
>
> **The lower left corner is at (nnn.nnn, nnnn.nnn) in UTM coordinates.**
>
> **EXPANSION operation is complete**

Upon completion, the Tektronix screen will be refreshed and the screen redrawn with the new file. If the area defined is not a square area, the program will make it a square starting at the defined lower left corner, and using the value for the height or width which is greater to determine the length of a side. New area added to the file to create a square screen view will have "zero" values entered for all data fields for each cell in the area.

Note: For an area which has been "squared" by the expansion program, and on which contour lines are being displayed, a thick brown line will normally appear along the "squared" edge of the terrain file. These are the contour lines which show the drop in elevation to the "0" meter level defined in the "squared" area.

Input Area

Selection of the INPUT AREA option will allow an area to be defined as a new terrain data set. When it is created it will also be expanded to a full 1000 x 1000 cells. Information required to define an area will be identified on the VT100 screen as follows:

> **The current lower left corner is nnn.nnn, nnnn.nnn.**
>
> **Enter new values or hit RETURN:**

"nnn.nnn, nnnn.nnn" represents a UTM grid coordinate number. The first two digits to the left of the decimal point of both number halves are the UTM Grid overlay

---

displayed on the Tektronix screen. Enter the numbers separated by a space. The comma is not necessary. After entering the location of the lower left corner the next message will appear:

The current width and height is nn.nnn km x nn.nnn km.

Enter new values or hit RETURN:

"nn.nnn km" represents the height or width in kilometers. Again, the values may be input separated with a space.

Upon completion of entering this data, the area defined will be defined on the Tektronix display, bordered in yellow, and the VT100 will report:

The proposed lower left corner is nnn.nnn, nnnn.nnn
The proposed width and height is nn.nnn, nn.nnn

Either continue to define the area by repeating this process, use the other DEFINE sub-menu options, or select any other menu option.

Lower Corner

Selection of the LOWER CORNER option will allow two sides of an area to be defined graphically on the Tektronix screen as a part of a process to define and create a new terrain data set. This option is used in conjunction with the UPPER CORNER option which graphically defines the other two sides of the area.

When the LOWER CORNER option is selected, the normal cursor displayed on the Tektronix will be replaced by a white cross. Place the centerpoint of the cross at the location of the lower left corner of the new area being defined, and press the yellow button. The Left and Bottom edges of the new area being defined will now be highlighted in yellow. The VT100 will report:

Lower corner is located at (nnn.nnn,   nnn.nnn) in UTM coordinates

This option can be repeated until the desired area is correctly defined. Once an area is defined the EXPAND/DEFINE option can be used to create the new file .

Upper Corner

Selection of the UPPER CORNER option will allow two sides of an area to be defined graphically on the Tektronix screen as a part of a process to define and create a new terrain data set. This option is used in conjunction with the LOWER CORNER option which graphically defines the other two sides of the area.

When the UPPER CORNER option is selected, the normal cursor displayed on the Tektronix will be replaced by a white cross. Place the centerpoint of the cross at the location of the upper right corner of the new area being defined, and press the yellow button. The Right and Top edges of the new area being defined will now be highlighted in yellow. The VT100 will report:

Upper corner is located at (nnn.nnn, nnn.nnn) in UTM coordinates

This option can be repeated until the desired area is correctly defined. Once an area is defined the EXPAND/DEFINE option can be used to create the new file.

UTM Grid

The UTM GRID option displays or erases the Universal Transverse Mercator (UTM) grid pattern associated with the terrain being displayed, each time it is selected. The grid interval is dependent on the size of the area being displayed, and remains active while other options are being used.

Rivers

Water features (rivers and lakes) may be added to the terrain using the RIVERS option. Upon selection of this option, all river data are highlighted, in white, on the screen. Yellow diamonds identify NODES which are the locations of all river starting and ending points as well as each bend in the river. The lines connecting these nodes are called LINKS.

When the RIVERS option is activated, the Tektronix screen will display the following help message:

xxx River nodes used out of a possible 2000

"xxx" is the number of nodes currently being used. This number will change as nodes are deleted or added to the Tektronix display. As stated, there is a limitation of 2000 river nodes which can be saved when writing a terrain file, however, a maximum of 5000 nodes may be input during the work session. The number of nodes input over the 2000 limit must be deleted before a new terrain file may be written. When modification to the river data is complete, select any other Main menu option, and the new river data will be redrawn in blue. The more nodes that are used, the longer it will take to redraw the screen and/or write a new file. To modify river data use the RIVERS sub-menu (Fig. 8). The RIVERS sub-menu has the following options: CREATE NODE, CREATE LINK, DELETE NODE, DELETE LINK, MOVE NODE, DELETE ALL, DIGITIZE, TRANSFER and DRAW LAKES.
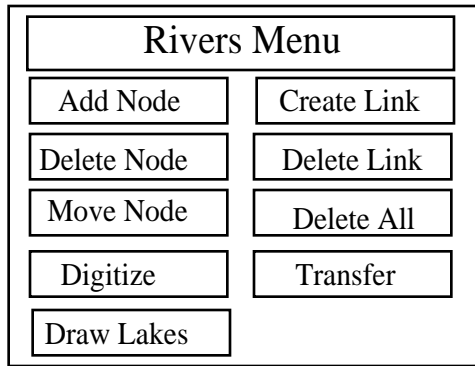
```
┌─────────────────────────────────┐
│  ┌───────────────────────────┐  │
│  │       Rivers Menu         │  │
│  └───────────────────────────┘  │
│  ┌────────────┐ ┌────────────┐  │
│  │  Add Node  │ │ Create Link│  │
│  └────────────┘ └────────────┘  │
│  ┌────────────┐ ┌────────────┐  │
│  │ Delete Node│ │ Delete Link│  │
│  └────────────┘ └────────────┘  │
│  ┌────────────┐ ┌────────────┐  │
│  │ Move Node  │ │ Delete All │  │
│  └────────────┘ └────────────┘  │
│  ┌────────────┐ ┌────────────┐  │
│  │  Digitize  │ │  Transfer  │  │
│  └────────────┘ └────────────┘  │
│  ┌────────────┐                 │
│  │ Draw Lakes │                 │
│  └────────────┘                 │
└─────────────────────────────────┘
```

Figure 8   Rivers   sub-menu

Create Node

Rivers are added to the terrain by selecting a point where the river is to start followed by additional points at each bend in the river. Each of these points is called a node, and are selected using the yellow button on the puck. As each additional node is picked, a line will connect it to the last picked node. This line is called a link, and represents the river. When the last node point is reached, select its location using any of the other puck buttons. Next, either select another starting point to begin another river, or another menu option.

Create Link

Additional links may be created between currently displayed nodes using this option. Select one of a pair of nodes to be linked, and it will begin flashing to indicate it has been selected. Select the second node, and the first node will stop flashing and the new link will appear. Next, either select another set of nodes to link, or another menu option.

Delete Node

Nodes currently displayed may be deleted using this option. As each node is selected it will be deleted along with all links which connect to other nodes. Continue to delete nodes no longer needed, or select another menu option.

Delete Link

Links currently displayed may be deleted using this option. Select a point anywhere along the link to be deleted, and it will disappear. If the link is very short and the cursor cannot be placed without overlapping node points, the link may not disappear. When this occurs use the ZOOM sub-menu options to magnify the area allowing a pick without interference from the node displays. Next, either continue to delete links, or select another menu option.

NOTE:	Nodes not connected by a link will be retained throughout the Terrain Editor process, but will be automatically deleted when the terrain file is saved as they serve no purpose.

Move Node

Nodes may be moved using this sub-menu option. Select the node to be moved, then pick the new location. The node will be moved to the desired position along with all connecting links. Next, either continue to move nodes, or select another menu option.

Delete All

The DELETE ALL option deletes all river nodes from the terrain file. If it is selected the following prompt will appear:

ARE you SURE you want to delete ALL river data (Y/N) ?

Enter **Y** to delete all river data. Enter **N** to abort the delete process.

Digitize Rivers

Digitizing rivers is identical to the DIGITIZE process in the CITIES sub-menu.

Transfer

River data contained in a secondary terrain file will be added to the screen. If a secondary terrain file has not been specified previously, the VT100 screen will ask for the type and file identification.

Draw Lakes

A river which completely encloses an area of land may be defined as a lake. To insure the area of land is completely enclosed used the CREATE LINK option to join the starting and end nodes of a river. Selection of this option will fill all enclosed areas with blue indicating their status as "lakes."

Roads

This option allows roads to be added to the terrain. Upon selection of this option, all road data are erased from the screen and redrawn in white. Yellow diamonds identify NODES which are the locations of all road starting and ending points as well as each bend in the road. The lines connecting these nodes are called LINKS.

When the ROADS option is activated, the Tektronic screen will display the following help   message:

xxx Road nodes used out of a possible 4000

"xxx" is the number of nodes currently being used. This number will change as nodes are deleted or added to the Tektronix display. As stated, there is a limitation of 4000 road nodes. When modification to the road data is complete, select any other Main menu option, and the new road data will be redrawn in brown. The more nodes that are used, the longer it will take to redraw the screen and/or write a new file. To modify road data use the ROADS sub-menu (Fig. 9). The ROADS sub-menu has the following options: CREATE NODE, CREATE LINK, DELETE NODE, DELETE LINK, MOVE NODE, DELETE ALL, DIGITIZE and TRANSFER.

```
┌─────────────────────────────────────┐
│        Roads Menu                    │
│  ┌──────────────┐ ┌──────────────┐   │
│  │  Add Node    │ │  Create Link │   │
│  └──────────────┘ └──────────────┘   │
│  ┌──────────────┐ ┌──────────────┐   │
│  │ Delete Node  │ │ Delete Link  │   │
│  └──────────────┘ └──────────────┘   │
│  ┌──────────────┐ ┌──────────────┐   │
│  │  Move Node   │ │  Delete All  │   │
│  └──────────────┘ └──────────────┘   │
│  ┌──────────────┐ ┌──────────────┐   │
│  │   Digitize   │ │   Transfer   │   │
│  └──────────────┘ └──────────────┘   │
└─────────────────────────────────────┘
```
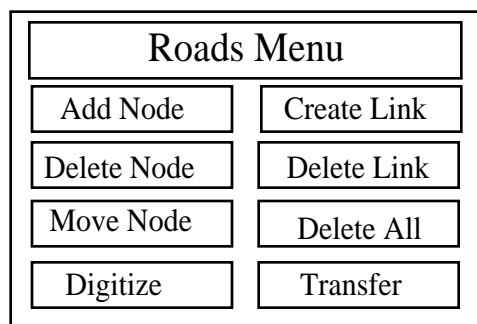
Figure   9   Roads   sub-menu

Create   Node

Roads are added to the terrain by selecting a point where the road is to start followed by additional points at each bend in the road. Each of these points is called a node, and is selected using the yellow button on the puck. As each additional node is picked, a line will connect it to the last picked node. This line is called a link, and represents the road. When the last node point is reached, select its location using any of the other puck buttons. Next, either select another starting point to begin another road, or another menu option.

Create   Link

Additional links may be created between currently displayed nodes using this option. Select one of a pair of nodes to be linked, and it will begin flashing to indicate it has been selected. Select the second node, and the first node will stop flashing and the new link will appear. Next, either select another set of nodes to link, or another menu   option.

Delete   Node

Nodes currently displayed may be deleted using this option. As each node is selected it will be deleted along with all links which connect to other nodes. Continue to delete nodes no longer needed, or select another menu option.

Delete   Link

Links currently displayed may be deleted using this option. Select a point anywhere along the link to be deleted, and it will disappear. If the link is very short and the cursor cannot be placed without overlapping node points, the link may not disappear. When this occurs use the ZOOM sub-menu options to magnify the area allowing a pick without interference from the node displays. Next, either continue to delete links, or select another menu option.

> NOTE: Nodes not connected by any links will be retained throughout the Terrain Editor process, but will be automatically deleted when the terrain file is saved as they serve no purpose.

Move   Node

Nodes may be moved using this sub-menu option. Select the node to be moved, then pick the new location. The node will be moved to the desired position along with all connecting links. Next, either continue to move nodes, or select another menu option.

Delete   All

The DELETE ALL option deletes all road nodes from the terrain file. If it is selected the following prompt will appear:

ARE you SURE you want to delete ALL road data (Y/N) ?

Enter **Y** to delete all road data. Enter **N** to abort the delete process.

Digitize   Roads

Digitizing roads is identical to the DIGITIZE process in the CITIES sub-menu.

Transfer

Road data contained in a secondary terrain file will be added to the screen. If a secondary terrain file has not been specified previously, the VT100 screen will ask for the type and file identification.

Trees

Trees or vegetation are displayed in varying shades of green on the screen,
representing seven types of vegetation based on density and height. Vegetated areas
may be input, modified, or deleted using the TREES sub-menu (Fig. 10). The TREES sub-
menu has the following options: DIGITIZE, REFRESH, TRANSFER, DELETE ALL, VALUE
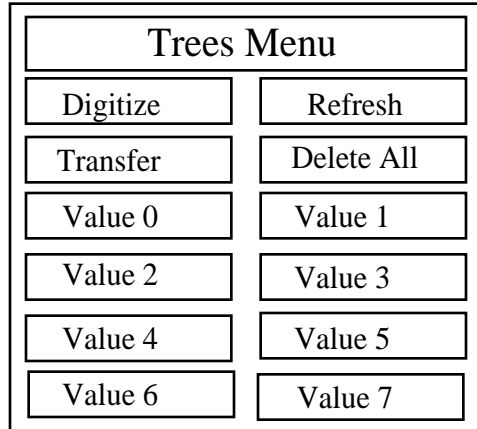0, VALUE 1, , VALUE 2, VALUE 3, VALUE 4, VALUE 5, VALUE 6 and VALUE 7.

```
+---------------------------------------+
|          Trees Menu                   |
| +-----------------+ +---------------+ |
| |    Digitize     | |    Refresh    | |
| +-----------------+ +---------------+ |
| |    Transfer     | |   Delete All  | |
| +-----------------+ +---------------+ |
| |    Value 0      | |    Value 1    | |
| +-----------------+ +---------------+ |
| |    Value 2      | |    Value 3    | |
| +-----------------+ +---------------+ |
| |    Value 4      | |    Value 5    | |
| +-----------------+ +---------------+ |
| |    Value 6      | |    Value 7    | |
| +-----------------+ +---------------+ |
+---------------------------------------+
```

Figure 10 Trees sub-menu

Digitize Trees

Digitizing trees is identical to the DIGITIZE process in the CITIES sub-menu.

Refresh

Selection of this sub-menu option causes all work displayed in shades of gray to be
redrawn on the screen in the proper shade of green. Be patient, this takes a few
moments.

Transfer

Tree data contained in a secondary terrain file will be added to the screen. If a
secondary terrain file has not been specified previously, the VT100 screen will ask
for the type and file identification.

Delete All

The DELETE ALL option deletes all tree data from the terrain file. If it is selected the
following prompt will appear:

ARE you SURE you want to delete ALL tree data (Y/N) ?

Enter **Y** to delete all trees data. Enter **N** to abort the delete process.

Trees   Values   (0-7)

Screen data is modified by selecting the value of trees desired, and defining the area to be filled with that value. Upon selection of the value, the cursor will be replaced with a writing quill. Using the quill like a pen, it will write whenever the yellow button on the puck is depressed and held. When the button is released, the quill will stop writing. Using the quill, draw a line which encloses the area to be filled leaving a small gap between the line ends which will be joined automatically when the button is released. The area will be filled by a shade of gray for easy identification indicating the tree value selected (dark gray=1 to white=7, orange=0). Continue to define areas using the current value or select a new one. Areas may be drawn over currently highlighted areas. To erase trees use VALUE 0.

When finished select REFRESH or any option from the Main menu.

NOTE:	If large areas of the screen are being changed, the segment memory space could be filled. If this happens, the terminal will beep. Respond by selecting REFRESH to store current plans which clears the memory area. Continue to make changes, but work with smaller areas.

Zoom

Selection of the ZOOM option elicits a sub-menu of options which allow definition and alteration of the large terrain view, to include magnification. This option may be used in conjunction with any of the other options. The ZOOM sub-menu (Fig. 11) options are: 1 %, 10 %, 25 %, 1:50,000, NEXT, OVERVIEW, PAN and PREVIOUS.

Zoom Menu	
1 %	10 %
25 %	1:50,000
Next	Overview
Pan	Previous

Figure   11   Zoom   sub-menu

Choosing the 1 %, 10 %, or 25 % option defines a window template one, ten or twenty-five percent of the size of the large screen view which replaces the cursor. The window may then be positioned on either the large screen view or the miniature screen view at the lower right corner of the screen. Pushing the yellow button finalizes the area selection causing the area encompassed by the box to replace and fill the large screen area. A white box will continue to be displayed on the miniature

view to maintain a perspective of what is being displayed within the large view area.
This option may be repeated several times for increased magnification. To cancel the
option once selected push any puck button other than yellow.

Choosing the 1:50,000 option defines a window template which will scale the screen
view equal to a real world map scale of 1:50,000, and operates identically to the 25%
sub-menu   option.

Choosing the OVERVIEW option returns the large terrain view to the original
overview display, and erases the white box displayed on the miniature terrain view.

Choosing the PAN option defines a window template the same size as the current
view, allowing the area in view to be changed but be displayed at the same scale.

Choosing the PREVIOUS option allows selection of the view previously defined before
the current view for display. Twenty-five zoom sub-menu selections are remembered
in sequential order beginning with the first option selection following the last
overview display. This option is normally used in conjunction with NEXT to alternate
view display of areas of interest.

Choosing the NEXT option allows selection of the view defined previous to the current
view. This option is normally used in conjunction with the PREVIOUS sub-menu
option to alternate view display of areas of interest.

Water

Water is displayed in varying shades of blue on the screen, representing seven
depths of water. Water areas may be input, modified, or deleted using the WATER sub-
menu (Fig. 12). The WATER sub-menu has the following options: DIGITIZE, REFRESH,
TRANSFER, DELETE ALL, VALUE 0, VALUE 1, , VALUE 2, VALUE 3, VALUE 4, VALUE 5,
VALUE 6 and VALUE 7.

Water Menu	
Digitize	Refresh
Transfer	Delete All
Value 0	Value 1
Value 2	Value 3
Value 4	Value 5
Value 6	Value 7

Figure 12 Water sub-menu

Digitize Water

Digitizing water is identical to the DIGITIZE process in the CITIES sub-menu.

Refresh

Selection of this sub-menu option causes all work displayed in shades of gray to be redrawn on the screen in the proper shade of blue. Be patient, this takes a few moments.

Transfer

Tree data contained in a secondary terrain file will be added to the screen. If a secondary terrain file has not been specified previously, the VT100 screen will ask for the type and file identification.

Delete All

The DELETE ALL option deletes all water data from the terrain file. If it is selected the following prompt will appear:

ARE you SURE you want to delete ALL water data (Y/N) ?

Enter **Y** to delete all water data. Enter **N** to abort the delete process.

Water Values (0-7)

Screen data are modified by selecting the value of water desired, and defining the area to be filled with that value. Upon selection of the value, the cursor will be replaced with a writing quill. Using the quill like a pen, it will write whenever the yellow button on the puck is depressed and held. When the button is released, the quill will stop writing. Using the quill, draw a line which encloses the area to be filled leaving a small gap between the line ends which will be joined automatically when the button is released. The area will be filled by a shade of gray for easy identification indicating the water value selected (dark gray=1 to white=7, orange=0). Continue to define areas using the current value or select a new one. Areas may be drawn over currently highlighted areas. To erase water use VALUE 0.

When finished select REFRESH or any option from the Main menu.

NOTE: If large areas of the screen are being changed, the segment memory space could be filled. If this happens, the terminal will beep. Respond by selecting

REFRESH to store current plans which clears the memory area. Continue to
make changes, but work with smaller areas.

Appendix A

Binary Terrain File Format

The JCM terrain file is stored in binary format. Eight data items are stored for each terrain cell. JCM currently allows up to 1000 x 1000 cells to be used. The data items are:

Elevation (lower left corner)

Tree/City/Water present (Boolean to indicate the presence of trees, urban, or water)

Tree/City density (uniformly distributed throughout cell) or Water depth (over entire cell)

Road (Boolean to indicate the presence of a road)

River (Boolean to indicate the presence of a river)

Tree/City blown down/rubbled (Boolean, this data is changed dynamically during a simulation,   and is not changed by the Terrain Editor)

Tree/City on fire (Boolean, this data is changed dynamically during a simulation, and is not changed by the Terrain Editor)

Military Obstacle Present   (Boolean, this data is changed dynamically during a simulation, and is not changed by the Terrain Editor)

Trafficability (not currently implemented)

Roughness (not currently implemented)

The Terrain Editor does not allow modification to elevation data, or data not implemented. It does allow input and modification to rivers, roads, trees (vegetation), cities (urban areas), and areas covered by water.

The binary file, organized as a sequential file, stores five sets of information (records).

The first set of information consists of the terrain file descriptors:

Lower left UTM	Floating	Two words: X and Y Coordinates
File width	Floating	Width of file in kilometers
File height	Floating	Height of file in kilometers
Grids wide	Integer	How many grid cells wide the file is (max 1000)
Grids tall	Integer	How many grid cells tall the file is (max 1000)
Upper right UTM	Floating	Two words: X and Y Coordinates
Width of cell	Floating	Cell width in kilometers
Height of cell	Floating	Cell height in kilometers
Inverse of width	Floating	One divided by cell width

Inverse of height	Floating	One divided by cell height
Latitude of Lower Left	Floating	Three words: degrees, minutes, seconds
Longitude of Lower Left	Floating	Three words: degrees, minutes, seconds
Meter conversion	Floating	Converts elevations to meters
Kilometer conversion	Floating	Converts elevations to kilometers
Feet conversion	Floating	Converts elevations to feet
Base elevation	Floating	Actual altitude of lowest point in file
Probability LOS blocked	Floating	Eight words: corresponding to density index (see **density index** in set four below)
Height	Floating	Eight words: corresponding to density index (see **density index** in set four below)
Trafficability	Floating	Eight words: corresponding to trafficability index (see **trafficability index** in set four below)
Roughness	Floating	Eight words: corresponding to micro-terrain roughness index (see **roughness index** in set four below)
Depth	Floating	Eight words: corresponding to Water depth (see **density index** in set four below)
Number River nodes	Integer	How many River nodes have been defined (max 2000)
Number Road nodes	Integer	How many Road nodes have been defined (max 4000)
File Area	Character	Eighty characters: file descriptive string
File Date	Integer	Three words: date file was first created (year, month, day)
File Time	Integer	Three words: time file was first created (hours, minutes, seconds)
File Source	Integer	Thirty Two bits: bits indicate which sources were used to generate the original file
File Meridian	Floating	Three words: longitude used as the central meridian for the UTM or UTM-like coordinate system for the map (degrees, minutes, seconds)
Future expansion	- - - -	Twenty Five words: set aside for future use

The second set of information consists of the list of river nodes (number of nodes indicated by "Number River nodes" field above:

River node   Floating Three Words per node: X, Y, and flag (+1.0 =
end of

string, 0.0 = node connects to next node, -1.0 =
last

node on list)

The third set of information consists of the list of road nodes (number of nodes
indicated by "Number Road nodes" field above:

Road node   Floating Three Words per node: X, Y, and flag (+1.0 =
end of

string, 0.0 = node connects to next node, -1.0 =
last

node on list)

The fourth set of information is the actual terrain data. To define an area of *m* by *n*
data cells, it is necessary to use *m+1* by *n+1* scan, or grid, lines. Each data point on
a scan line contains several bit-packed fields, the ones of primary interest being the
elevation at the data point, the tree/city density present in the grid cell (whose lower
left corner is the data point), and the presence or absence of a river/road in that grid
cell. The bit-packed fields which describe the terrain are organized into 32 bits per
data point as follows:

0 - 15	Elevation (16 least significant bits)
16	River present in cell flag
17	Military obstacle present in cell flag
18	Contents of cell on fire flag
19	Contents of cell blown down flag
20	Road present in cell flag
21 - 22	Trafficability index (0-3; not currently used)
23 - 25	Roughness index (0-7; not currently used)
26- 28	Density index (0-7; concealment and height for trees

and
Urban areas, depth for water areas)

29	Cell is urban area flag
30	Cell is covered by trees flag
31	Cell is covered by water flag

The fifth set of information contains the river search frames. The individual line
segments which make up the rivers are allocated to different search frames based on
their location relative to the edges of the terrain file. This technique is used to speed
up the search when trying to determine whether or not a unit is trying to cross a
river whenever it moves.

Schematically, the binary format terrain file looks like this:

File   Descriptors
River   Block
Road Block
Terrain   Block
Search   Frames

Appendix B

Problem Notes

Depending on the amount of memory resident in the Tektronix terminal being used, a situation may occur where a terrain data file created at a workstation with more memory is too large for the memory available at the current workstation. This is most likely to occur when a small contour interval is selected to initialize the file. This situation causes the Tektronix terminal to operate erratically due to memory overflow as evidenced by a faulty graphics display. (It will be obvious that something is wrong.)

To correct the situation, cancel the Terrain Editor by pressing the **CONTROL** and **Y** keys simultaneously, and push the **RESET** button on the Tektronix terminal to clear the faulty graphics. Restart the Terrain Editor without specifying a contour interval, which should allow display of the file and modification of all other data. Write a file to save the work accomplished, then experiment with varying contour intervals until an adequate graphic display is achieved.